PATENT ABSTRACTS OF JAPAN

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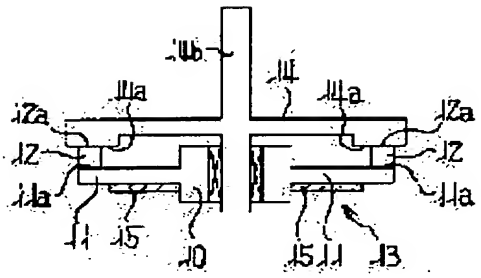
(54) DRIVING MECHANISM

(57)Abstract:
PURPOSE: To provide a flat, small-size and highly efficient vibrating reed-type driving mechanism by thrusting up a driving piece installed at a free end of a cantilever against a moving body with vibration due to a resonance of the free end of the cantilever.
CONSTITUTION: An ultrasonic motor from which a rotary movement is taken out is constituted of a stator 13 which is made by setting an end 12a of a flat slant piece 12, which will become a driving piece, on an upper surface of a free end 11a of each of the plurality of cantilevers 11 extending radially from a boss 10, a supporting section, and a rotor 14 which is pressure-welded to the end 12a of the slant piece 12 and which will become a moving body. When each piezoelectric element 15 is driven by a driving device at a primary motion, resonance frequency of the cantilever 11, the free end 11a of the cantilever 11 vibrates with a large displacement. In an outward the slant piece 12 installed at the free end 11a of the cantilever 11 is thrusted up against the rotor 14 and is bent in the inclined direction, rotating the rotor 14 in the bending direction. In an inward motion, on the other hand, the slant piece 12 is separated from the rotor 14. By repetition of this movement, a locus of the end 12a of the slant piece 12 is formed and this is the working of the ultrasonic motor.



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CLAIMS

[Claim(s)]
[Claim 1] The drive characterized by consisting of two or more cantilevers which it was fixed to the supporter, and the end was made to meet in the migration direction of a mobile, and were arranged, the piece of a drive which the pressure welding was carried out to said mobile in the tip, was supported by the free end of said cantilever in the back end, and was leaned in the migration direction of said mobile, an ultrasonic vibrator attached in said cantilever, and a driving means which drives this ultrasonic vibrator.
[Claim 2] The drive according to claim 1 characterized by ** made into two or more driving means which shift the phase of each ultrasonic vibrator suitably and drive it [claim 3] The drive according to claim 1 characterized by having formed in one the piezoelectric device attached in two or more cantilevers, and changing the direction of polarization of the anchoring section with said cantilever of this piezoelectric device.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the drive used in fields, such as OA equipment, such as PPC, facsimile, and a printer, a camera, and a machine tool.
[0002]
[Description of the Prior Art] In recent years, the ultrasonic motor has attracted attention in the descriptions, such as a controllability and large torque in low rotation.
[0003] The working principle of an ultrasonic motor changes into movement of an one direction the supersonic vibration which vibrator generated through frictional force as known well. This movement conversion is usually based on vibration of an ellipse locus.
[0004] This ellipse movement is realized by the approach generally shown below. What was shown in JP,59-122385,A has obtained ellipse movement by the longitudinal wave which the oscillating body surface was made to generate, and the progressive wave by which the transverse wave was compounded, and what was shown in JP,61-121777,A has obtained ellipse movement by the longitudinal-oscillation child and the torsional-oscillation child. Moreover, although it repeats that what is generally called a "vibrating reed type" dashes tip 2a of the piece 2 of an inclination which was made to incline as shown in drawing 16 , and was attached in vibrator 1 against a mobile 3, ellipse movement is obtained and the mobile 3 is moved, it is known that the ultrasonic motor of this "vibrating reed type" is very efficient as compared with other approaches.
[0005] Then, some ultrasonic motors of a "vibrating reed type" are shown.
[0006] What was shown in drawing 17 is typical, and it is the trembler of a run undergarment mold, two or more pieces 8 of an inclination are attached in the end face of said trembler 4, and the tremblers 4 and 5 and piezoelectric devices 6 and 7 which are bound tight with the drawing

semi-finished bolt are arranged so that Rota 9 may be stuck to tip 8a of the piece 8 of an inclination by pressure. With such a configuration, if piezoelectric devices 6 and 7 are driven, the end face of vibrator 4 and 5 vibrates at right angles to a field, and the piece 8 of an inclination will poke Rota 9, and will drive Rota 9.

[0007] Next, it is the proposal for decreasing wear of the field where the piece of an inclination which is the fault of a "vibrating reed type", and the piece of an inclination run which was shown in JP,60-62880,A, and it has dashed the field which replaced the piece of an inclination and included rotation.

[0008] Continuing, what was shown in JP,59-30912,A is the proposal which can change a hand of cut, and has formed 2 sets of flat ultrasonic motors which changed the hand of cut on the same axle.

[0009]

[Problem(s) to be Solved by the Invention] Although what was shown in drawing 17 is using the trembler of a run undergarment mold since ellipse movement by the deflection of the piece of an inclination does not generate the ultrasonic motor of a "vibrating reed type" here if it has the large amplitude and does not dash the piece of an inclination, this run undergarment type of trembler needs thickness for the oscillating direction theoretically, in order to use resonance of a longitudinal wave, and a flat miniaturization has unreasonableness.

[0010] Moreover, fundamentally, since it is the same as a run undergarment mold, what was shown in JP,60-62880,A needs thickness for the oscillating direction, and a flat miniaturization has unreasonableness.

[0011] Moreover, although what was shown in JP,59-30912,A is flat, it still needs consideration for the approach of dashing the piece of an inclination against Rota not to be described by the large amplitude, but realize a compact.

[0012] Moreover, in these ultrasonic motors, although the piece of an inclination and Rota are carrying out friction contact at the time of ****** of vibrator, since it is separated at the time of ******, it especially becomes an intermittent drive and there are decline in drive effectiveness and rotational deflection at the time of a heavy load.

[0013] Therefore, this invention aims at offering the drive of a flatly small and efficient a "vibrating reed type."

[0014]

[Means for Solving the Problem] It considered as the drive which consists of two or more cantilevers which it was fixed to the supporter, and the end was made to meet in the migration direction of a mobile in invention according to claim 1, and were arranged, the piece of a drive which the pressure welding was carried out to said mobile in the tip, was supported by the free end of said cantilever in the back end, and was leaned in the migration direction of said mobile, an ultrasonic vibrator attached in said cantilever, and a driving means which drives this ultrasonic vibrator.

[0015] In invention according to claim 2, it considered as two or more driving means which shift the phase of each supersonic vibration suitably and drive it.

[0016] In invention according to claim 3, the piezoelectric device attached in two or more cantilevers was formed in one, and the direction of polarization of the anchoring section with said cantilever of this piezoelectric device was changed.

[0017]

[Function] If an ultrasonic vibrator is driven with the primary resonance frequency of a cantilever by the driving means, since the free end of a cantilever will vibrate by resonance according to invention according to claim 1, the piece of a drive attached in this free end also vibrates. Since this piece of a drive is leaned and forced on the mobile, it is forced so that it may thrust up to a mobile at the time of ****** of vibration, it is crooked in the inclination direction, and sends out a mobile in the migration direction. Moreover, although the piece of a drive is separated from a mobile at the time of ******, a mobile continues moving in the migration direction according to own inertia. A mobile is driven by this repetition.

[0018] If each ultrasonic vibrator is shifted and a phase is driven by two or more driving means, since according to invention according to claim 2 each cantilever will change a phase,

respectively and will vibrate, the timing to which each piece of a drive drives a mobile distributes, and the non-driven time amount which the piece of a drive is ******(ing) becomes short as a whole. Therefore, the back-migration of the mobile at the time of no driving and the fall of passing speed decrease, and a mobile is efficient and is moved smoothly.

[0019] Since the piezoelectric device attached in two or more cantilevers was formed by one according to invention according to claim 3 Since the installation to a cantilever is easy, and wiring can also be managed with 1 set and the direction of polarization of the anchoring section with the cantilever of the piezoelectric device formed by one is changed, When one piece of an inclination is separated from the mobile, the piece of an inclination of another side is poking the mobile, and the non-driven time amount which the piece of an inclination is ******(ing) becomes short as a whole. Therefore, a mobile is efficient and is moved smoothly.

[0020]

[Example] The first example of this invention is explained based on drawing 1 thru/or drawing 6 . This example consists of Rota 14 which serves as the stator 13 which formed the tabular piece 12 of an inclination used as the piece of a drive in the top face of free-end 11a of two or more cantilevers 11 extended to the radial, and was formed in it, and a mobile which carried out the pressure welding to tip 12a of said piece 12 of an inclination from the boss 10 who is the ultrasonic motor which takes out rotation, and becomes a supporter as shown in drawing 1 thru/or drawing 4 .

[0021] Rotation of this Rota 14 is enabled at said boss 10 through shaft 14b which has friction section 14a contacted by the inferior-surface-of-tongue periphery with tip 12a of said piece 12 of an inclination, and was prepared in the core. Moreover, said stator 13 begins to be deleted from SK material, and is formed by one, and in that case, said piece 12 of an inclination advances tip 12a to the hand of cut in said Rota 14, and is leaned. furthermore -- the inferior surface of tongue of said boss 10 near [said cantilever 11] -- the piezoelectric device 15 as an ultrasonic vibrator -- pasting ********.

[0022] Moreover, said stator 13 and said Rota 14 are made to maintain a mutual pressure-welding condition by the spring member which it is dedicated to the case which is not illustrated and is not illustrated.

[0023] In such a configuration, if each piezoelectric device 15 is driven with the primary resonance frequency of a cantilever 11 by the driving means which is not illustrated, as shown in drawing 5 and 6, free-end 11a of a cantilever 11 will vibrate with a big variation rate. The piece 12 of an inclination attached in free-end 11a of a cantilever 11 on the occasion of ****** shown in drawing 5 is forced so that it may thrust up to Rota 14, as shown in drawing 5 (b), is crooked in the inclination direction of the piece 12 of an inclination, and rotates Rota 14 in the crookedness direction. Moreover, in the case of double vibration shown in drawing 6 , the piece 12 of an inclination separates from Rota 14. The locus of tip 12a of the piece 12 of an inclination obtained by this repetition serves as an ellipse, namely, has become an operation of the ultrasonic motor of a "vibrating reed type." Thus, in this example, the ultrasonic motor of a "vibrating reed type" with high effectiveness can be made flatly small.

[0024] Moreover, in this example, if each piezoelectric device 15 is shifted by two or more driving means and a phase is driven, the timing to which each piece 12 of an inclination drives Rota 14 distributes, and the non-driven time amount which the piece 12 of an inclination is ******(ing) becomes short as a whole, and the inversion of Rota 14 at the time of no driving and reduction of rotational speed will decrease, and it will become the ultrasonic motor of efficient and smooth rotation. If it is made for the piece 12 of an inclination which drives the group of 12-a shown in drawing 7 (a) and (b) and 12-b with the same phase at this time, and is driven and driven by the piece 12 of an inclination of the always same number to be equally distributed on a periphery, driving force will serve as an ultrasonic motor of the rotation which started Rota 14 with sufficient balance and was stabilized further.

[0025] It continues and the second example of this invention is explained based on drawing 8 and drawing 9 . The same part as the part shown in said example is shown using the same sign (suppose that it is the same also in the following examples). In this example, the disc-like piezoelectric device 16 which changes to the piezoelectric device 15 of said example, and is shown

in drawing 8 is stuck on the stator 13 (drawing 9). This piezoelectric device 16 cuts a slot deeply to a disc-like piezoelectric device, and each piezoelectric-device 16a corresponding to a cantilever 11 is formed, and the direction of polarization of each piezoelectric-device 16a is made reverse every 16a2 piezoelectric devices, and he makes the number of + polarization and - polarization into the same number, and is trying to distribute each polarization equally on a periphery.

[0026] In such a configuration, even if it drives a piezoelectric device 16 by one driving means, when the piece 12 of an inclination changes the phase of vibration 180 degrees every two, and vibrates to it, one piece 12 of an inclination ****** the piezoelectric device which changed polarization, since the flexible direction becomes reverse and it is distant from Rota 14, another piece 12 of an inclination ****** and is driving Rota 14. Therefore, the time amount which Rota 14 is not driving is short as a whole, and effectiveness serves as a good rotational smooth ultrasonic motor. Furthermore, since it is distributed equally [the piece 12 of the inclination which is driving by the piece 12 of the inclination of the always same number and is driven since it is distributed equally / making the number of + polarization and - polarization into the same number / each polarization / on a periphery] on a periphery and Rota 14 is started with sufficient balance of driving force, it will become smoother. Moreover, for the structure made into one, adhesion to a stator can be managed with once, wiring to a driving means can also be further managed with a lot, and a piezoelectric device 16 can simplify the assembly process at the time of production.

[0027] Moreover, two or more driving means needless to say, then still finer phase division (twice of the number of driving means) can be performed, and effectiveness becomes the high thing of smooth rotation more.

[0028] Below, the third example of this invention is explained based on drawing 10 and drawing 11 . This example is the ultrasonic linear motor which takes out rectilinear motion, the piece 12 of an inclination is formed in the top face of free-end 18a of two or more cantilevers 18 established in the rod-like supporter 17 with the cross-section rectangle, a stator 19 is formed, and the pressure welding of the mobile 20 of a cross-section rectangle is carried out to tip 12a of the piece 12 of an inclination of this stator 19. Moreover, the piece 12 of an inclination attached in said cantilever 18 advances tip 12a to the travelling direction of said mobile 20, and is leaned. Furthermore, the piezoelectric device 21 as an ultrasonic vibrator is stuck on the inferior surface of tongue of the cantilever 18 of said stator 19.

[0029] In such a configuration, if each piezoelectric device 21 is driven with the primary resonance frequency of a cantilever 18 by the driving means which is not illustrated, a cantilever 18 will vibrate, and the piece 12 of an inclination prepared in the free-end 18a is forced so that it may thrust up to a mobile 20, it is crooked in the inclination direction of the piece 12 of an inclination, and moves a mobile 20 in the crookedness direction. A mobile 20 is driven by this repetition.

[0030] Below, the fourth example of this invention is explained based on drawing 12 and drawing 13 . It is the ultrasonic linear motor which can carry out adjustable [of the migration direction of a mobile], and as the stator 19 of said example makes the inclination direction of the oscillating piece 12 reverse, and this example crosses by turns, it goes and the bubble of the mutual cantilever 18 is carried out.

[0031] one of two stators 19 which faced each other in such a configuration -- if one of the two is driven, since a mobile 20 will move in the inclination direction of the oscillating piece 12 of the stator 19, by choosing the stator to drive, the migration direction of a mobile 20 can be chosen and it can carry out adjustable [of the migration direction of a mobile 20].

[0032] Below, the fifth example of this invention is explained based on drawing 14 and drawing 15 . As well as the first example, although this example is an ultrasonic motor which takes out rotation, it can choose a hand of cut. Although the fundamental configuration is the same as the first example, as shown in drawing 15 , piece of inclination 12-alpha is leaned in the direction of a RRC, and piece of inclination 12-beta is leaned in the direction of a RLC.

[0033] In such a configuration, since the RRC of Rota 14 will be carried out if only the group of piece of inclination 12-alpha is driven, and the RLC of Rota 14 will be carried out if only the group of piece of inclination 12-beta is driven, a hand of cut can be chosen.

[0034] In addition, in an old example, although only one piece of an inclination is prepared in one cantilever, it may not restrict to this, and two or more pieces of an inclination may be prepared in one cantilever. Wear of the field where the piece of an inclination and the piece of an inclination hit can be made small by doing in this way.
[0035]
[Effect of the Invention] Since the piece of a drive attached in the free end of this cantilever by vibration by resonance of the free end of a cantilever was dashed against the mobile according to invention according to claim 1, compared with what used the vibrator of the conventional run undergarment mold, it becomes the drive of a flat small "vibrating reed type."
[0036] According to invention according to claim 2, since the phase of each ultrasonic vibrator is shifted suitably and can be driven, the timing to which each piece of a drive drives a mobile is distributed, and non-driven time amount which the piece of a drive is ******(ing) can be shortened as a whole. Therefore, it becomes the drive which the back-migration of the mobile at the time of no driving and the fall of passing speed decrease, and can be efficient and can move a mobile smoothly.
[0037] Since the piezoelectric device attached in two or more cantilevers was formed by one according to invention according to claim 3, the installation to a cantilever is easy and wiring can also be managed with 1 set. Moreover, since the drive by one driving means is also changing the direction of polarization of the anchoring section with the cantilever of the piezoelectric device formed by one, when one piece of a drive is separated from the mobile, the piece of a drive of another side comes to poke a mobile, and non-driven time amount which the piece of a drive is ******(ing) can be shortened as a whole. Therefore, it becomes the drive which can move a mobile that it is efficient and smoothly, and cost does not require.

TECHNICAL FIELD

[Industrial Application] This invention relates to the drive used in fields, such as OA equipment, such as PPC, facsimile, and a printer, a camera, and a machine tool.

PRIOR ART

[Description of the Prior Art] In recent years, the ultrasonic motor has attracted attention in the descriptions, such as a controllability and large torque in low rotation.
[0003] The working principle of an ultrasonic motor changes into movement of an one direction the supersonic vibration which vibrator generated through frictional force as known well. This movement conversion is usually based on vibration of an ellipse locus.
[0004] This ellipse movement is realized by the approach generally shown below. What was shown in JP,59-122385,A has obtained ellipse movement by the longitudinal wave which the oscillating body surface was made to generate, and the progressive wave by which the transverse wave was compounded, and what was shown in JP,61-121777,A has obtained ellipse movement by the longitudinal-oscillation child and the torsional-oscillation child. Moreover, although it repeats that what is generally called a "vibrating reed type" dashes tip 2a of the piece 2 of an inclination which was made to incline as shown in drawing 16 , and was attached in vibrator 1 against a mobile 3, ellipse movement is obtained and the mobile 3 is moved, it is known that the ultrasonic motor of this "vibrating reed type" is very efficient as compared with other approaches.
[0005] Then, some ultrasonic motors of a "vibrating reed type" are shown.
[0006] What was shown in drawing 17 is typical, and it is the trembler of a run undergarment mold, two or more pieces 8 of an inclination are attached in the end face of said trembler 4, and the tremblers 4 and 5 and piezoelectric devices 6 and 7 which are bound tight with the drawing semi-finished bolt are arranged so that Rota 9 may be stuck to tip 8a of the piece 8 of an inclination by pressure. With such a configuration, if piezoelectric devices 6 and 7 are driven, the end face of vibrator 4 and 5 vibrates at right angles to a field, and the piece 8 of an inclination will poke Rota 9, and will drive Rota 9.

[0007] Next, it is the proposal for decreasing wear of the field where the piece of an inclination which is the fault of a "vibrating reed type", and the piece of an inclination run which was shown in JP,60-62880,A, and it has dashed the field which replaced the piece of an inclination and included rotation.
[0008] Continuing, what was shown in JP,59-30912,A is the proposal which can change a hand of cut, and has formed 2 sets of flat ultrasonic motors which changed the hand of cut on the same axle.

EFFECT OF THE INVENTION

[Effect of the Invention] Since the piece of a drive attached in the free end of this cantilever by vibration by resonance of the free end of a cantilever was dashed against the mobile according to invention according to claim 1, compared with what used the vibrator of the conventional run undergarment mold, it becomes the drive of a flat small "vibrating reed type."
[0036] According to invention according to claim 2, since the phase of each ultrasonic vibrator is shifted suitably and can be driven, the timing to which each piece of a drive drives a mobile is distributed, and non-driven time amount which the piece of a drive is ******(ing) can be shortened as a whole. Therefore, it becomes the drive which the back-migration of the mobile at the time of no driving and the fall of passing speed decrease, and can be efficient and can move a mobile smoothly.
[0037] Since the piezoelectric device attached in two or more cantilevers was formed by one according to invention according to claim 3, the installation to a cantilever is easy and wiring can also be managed with 1 set. Moreover, since the drive by one driving means is also changing the direction of polarization of the anchoring section with the cantilever of the piezoelectric device formed by one, when one piece of a drive is separated from the mobile, the piece of a drive of another side comes to poke a mobile, and non-driven time amount which the piece of a drive is ******(ing) can be shortened as a whole. Therefore, it becomes the drive which can move a mobile that it is efficient and smoothly, and cost does not require.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Although what was shown in drawing 17 is using the trembler of a run undergarment mold since ellipse movement by the deflection of the piece of an inclination does not generate the ultrasonic motor of a "vibrating reed type" here if it has the large amplitude and does not dash the piece of an inclination, this run undergarment type of trembler needs thickness for the oscillating direction theoretically, in order to use resonance of a longitudinal wave, and a flat miniaturization has unreasonableness.
[0010] Moreover, fundamentally, since it is the same as a run undergarment mold, what was shown in JP,60-62880,A needs thickness for the oscillating direction, and a flat miniaturization has unreasonableness.
[0011] Moreover, although what was shown in JP,59-30912,A is flat, it still needs consideration for the approach of dashing the piece of an inclination against Rota not to be described by the large amplitude, but realize a compact.
[0012] Moreover, in these ultrasonic motors, although the piece of an inclination and Rota are carrying out friction contact at the time of ****** of vibrator, since it is separated at the time of ******, it especially becomes an intermittent drive and there are decline in drive effectiveness and rotational deflection at the time of a heavy load.
[0013] Therefore, this invention aims at offering the drive of a flatly small and efficient a "vibrating reed type."

MEANS

[Means for Solving the Problem] It considered as the drive which consists of two or more cantilevers which it was fixed to the supporter, and the end was made to meet in the migration

direction of a mobile in invention according to claim 1, and were arranged, the piece of a drive which the pressure welding was carried out to said mobile in the tip, was supported by the free end of said cantilever in the back end, and was leaned in the migration direction of said mobile, an ultrasonic vibrator attached in said cantilever, and a driving means which drives this ultrasonic vibrator.

[0015] In invention according to claim 2, it considered as two or more driving means which shift the phase of each supersonic vibration suitably and drive it.

[0016] In invention according to claim 3, the piezoelectric device attached in two or more cantilevers was formed in one, and the direction of polarization of the anchoring section with said cantilever of this piezoelectric device was changed.

OPERATION

[Function] If an ultrasonic vibrator is driven with the primary resonance frequency of a cantilever by the driving means, since the free end of a cantilever will vibrate by resonance according to invention according to claim 1, the piece of a drive attached in this free end also vibrates. Since this piece of a drive is leaned and forced on the mobile, it is forced so that it may thrust up to a mobile at the time of ****** of vibration, it is crooked in the inclination direction, and sends out a mobile in the migration direction. Moreover, although the piece of a drive is separated from a mobile at the time of ******, a mobile continues moving in the migration direction according to own inertia. A mobile is driven by this repetition.

[0018] If each ultrasonic vibrator is shifted and a phase is driven by two or more driving means, since according to invention according to claim 2 each cantilever will change a phase, respectively and will vibrate, the timing to which each piece of a drive drives a mobile distributes, and the non-driven time amount which the piece of a drive is ******(ing) becomes short as a whole. Therefore, the back-migration of the mobile at the time of no driving and the fall of passing speed decrease, and a mobile is efficient and is moved smoothly.

[0019] Since the piezoelectric device attached in two or more cantilevers was formed by one according to invention according to claim 3, The installation to a cantilever is easy, wiring can also be managed with 1 set, and since the direction of polarization of the anchoring section with the cantilever of the piezoelectric device formed by one is changed, when one piece of an inclination is separated from the mobile, the piece of an inclination of another side is poking a mobile, and the non-driven time amount which the piece of an inclination is ******(ing) becomes short as a whole. Therefore, a mobile is efficient and is moved smoothly.

EXAMPLE

[Example] The first example of this invention is explained based on drawing 1 thru/or drawing 6 . This example consists of Rota 14 which serves as the stator 13 which formed the tabular piece 12 of an inclination used as the piece of a drive in the top face of free-end 11a of two or more cantilevers 11 extended to the radial, and was formed in it, and a mobile which carried out the pressure welding to tip 12a of said piece 12 of an inclination from the boss 10 who is the ultrasonic motor which takes out rotation, and becomes a supporter as shown in drawing 1 thru/or drawing 4 .

[0021] Rotation of this Rota 14 is enabled at said boss 10 through shaft 14b which has friction section 14a contacted by the inferior-surface-of-tongue periphery with tip 12a of said piece 12 of an inclination, and was prepared in the core. Moreover, said stator 13 begins to be deleted from SK material, and is formed by one, and in that case, said piece 12 of an inclination advances tip 12a to the hand of cut in said Rota 14, and is leaned. furthermore -- the inferior surface of tongue of said boss 10 near [said cantilever 11] -- the piezoelectric device 15 as an ultrasonic vibrator -- pasting ********.

[0022] Moreover, said stator 13 and said Rota 14 are made to maintain a mutual pressure-welding condition by the spring member which it is dedicated to the case which is not

illustrated and is not illustrated.
[0023] In such a configuration, if each piezoelectric device 15 is driven with the primary resonance frequency of a cantilever 11 by the driving means which is not illustrated, as shown in drawing 5 and 6, free-end 11a of a cantilever 11 will vibrate with a big variation rate. The piece 12 of an inclination attached in free-end 11a of a cantilever 11 on the occasion of ****** shown in drawing 5 is forced so that it may thrust up to Rota 14, as shown in drawing 5 (b), is crooked in the inclination direction of the piece 12 of an inclination, and rotates Rota 14 in the crookedness direction. Moreover, in the case of double vibration shown in drawing 6 , the piece 12 of an inclination separates from Rota 14. The locus of tip 12a of the piece 12 of an inclination obtained by this repetition serves as an ellipse, namely, has become an operation of the ultrasonic motor of a "vibrating reed type." Thus, in this example, the ultrasonic motor of a "vibrating reed type" with high effectiveness can be made flatly small.
[0024] Moreover, in this example, if each piezoelectric device 15 is shifted by two or more driving means and a phase is driven, the timing to which each piece 12 of an inclination drives Rota 14 distributes, and the non-driven time amount which the piece 12 of an inclination is ******(ing) becomes short as a whole, and the inversion of Rota 14 at the time of no driving and reduction of rotational speed will decrease, and it will become the ultrasonic motor of efficient and smooth rotation. If it is made for the piece 12 of an inclination which drives the group of 12-a shown in drawing 7 (a) and (b) and 12-b with the same phase at this time, and is driven and driven by the piece 12 of an inclination of the always same number to be equally distributed on a periphery, driving force will serve as an ultrasonic motor of the rotation which started Rota 14 with sufficient balance and was stabilized further.
[0025] It continues and the second example of this invention is explained based on drawing 8 and drawing 9 . The same part as the part shown in said example is shown using the same sign (suppose that it is the same also in the following examples). In this example, the disc-like piezoelectric device 16 which changes to the piezoelectric device 15 of said example, and is shown in drawing 8 is stuck on the stator 13 (drawing 9). This piezoelectric device 16 cuts a slot deeply to a disc-like piezoelectric device, and each piezoelectric-device 16a corresponding to a cantilever 11 is formed, and the direction of polarization of each piezoelectric-device 16a is made reverse every 16a2 piezoelectric devices, and he makes the number of + polarization and - polarization into the same number, and is trying to distribute each polarization equally on a periphery.
[0026] In such a configuration, even if it drives a piezoelectric device 16 by one driving means, when the piece 12 of an inclination changes the phase of vibration 180 degrees every two, and vibrates to it, one piece 12 of an inclination ****** the piezoelectric device which changed polarization, since the flexible direction becomes reverse and it is distant from Rota 14, another piece 12 of an inclination ****** and is driving Rota 14. Therefore, the time amount which Rota 14 is not driving is short as a whole, and effectiveness serves as a good rotational smooth ultrasonic motor. Furthermore, since it is distributed equally [the piece 12 of the inclination which is driving by the piece 12 of the inclination of the always same number and is driven since it is distributed equally / making the number of + polarization and - polarization into the same number / each polarization / on a periphery] on a periphery and Rota 14 is started with sufficient balance of driving force, it will become smoother. Moreover, for the structure made into one, adhesion to a stator can be managed with once, wiring to a driving means can also be further managed with a lot, and a piezoelectric device 16 can simplify the assembly process at the time of production.
[0027] Moreover, two or more driving means needless to say, then still finer phase division (twice of the number of driving means) can be performed, and effectiveness becomes the high thing of smooth rotation more.
[0028] Below, the third example of this invention is explained based on drawing 10 and drawing 11 . This example is the ultrasonic linear motor which takes out rectilinear motion, the piece 12 of an inclination is formed in the top face of free-end 18a of two or more cantilevers 18 established in the rod-like supporter 17 with the cross-section rectangle, a stator 19 is formed, and the pressure welding of the mobile 20 of a cross-section rectangle is carried out to tip 12a of the piece 12 of an inclination of this stator 19. Moreover, the piece 12 of an inclination attached

in said cantilever 18 advances tip 12a to the travelling direction of said mobile 20, and is leaned. Furthermore, the piezoelectric device 21 as an ultrasonic vibrator is stuck on the inferior surface of tongue of the cantilever 18 of said stator 19.

[0029] In such a configuration, if each piezoelectric device 21 is driven with the primary resonance frequency of a cantilever 18 by the driving means which is not illustrated, a cantilever 18 will vibrate, and the piece 12 of an inclination prepared in the free-end 18a is forced so that it may thrust up to a mobile 20, it is crooked in the inclination direction of the piece 12 of an inclination, and moves a mobile 20 in the crookedness direction. A mobile 20 is driven by this repetition.

[0030] Below, the fourth example of this invention is explained based on drawing 12 and drawing 13 . It is the ultrasonic linear motor which can carry out adjustable [of the migration direction of a mobile], and as the stator 19 of said example makes the inclination direction of the oscillating piece 12 reverse, and this example crosses by turns, it goes and the bubble of the mutual cantilever 18 is carried out.

[0031] one of two stators 19 which faced each other in such a configuration -- if one of the two is driven, since a mobile 20 will move in the inclination direction of the oscillating piece 12 of the stator 19, by choosing the stator to drive, the migration direction of a mobile 20 can be chosen and it can carry out adjustable [of the migration direction of a mobile 20].

[0032] Below, the fifth example of this invention is explained based on drawing 14 and drawing 15 . As well as the first example, although this example is an ultrasonic motor which takes out rotation, it can choose a hand of cut. Although the fundamental configuration is the same as the first example, as shown in drawing 15 , piece of inclination 12-alpha is leaned in the direction of a RRC, and piece of inclination 12-beta is leaned in the direction of a RLC.

[0033] In such a configuration, since the RRC of Rota 14 will be carried out if only the group of piece of inclination 12-alpha is driven, and the RLC of Rota 14 will be carried out if only the group of piece of inclination 12-beta is driven, a hand of cut can be chosen.

[0034] In addition, in an old example, although only one piece of an inclination is prepared in one cantilever, it may not restrict to this, and two or more pieces of an inclination may be prepared in one cantilever. Wear of the field where the piece of an inclination and the piece of an inclination hit can be made small by doing in this way.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the sectional side elevation showing the first example of this invention.

[Drawing 2] It is the top view showing a stator.

[Drawing 3] It is the sectional side elevation showing a stator.

[Drawing 4] It is the enlarged drawing of the piece of an inclination seen from drawing 3 arrow-head A.

[Drawing 5] It is the explanatory view showing ****** of vibration of a cantilever.

[Drawing 6] It is the explanatory view showing ****** of vibration of a cantilever.

[Drawing 7] It is the explanatory view showing drive distribution of a cantilever.

[Drawing 8] The piezoelectric device of the second example of this invention is shown, and the top view (b) of (a) is a sectional side elevation.

[Drawing 9] It is the top view showing the stator which was able to stick the piezoelectric device.

[Drawing 10] It is the top view showing the stator of the third example of this invention.

[Drawing 11] It is the side elevation showing a stator and a mobile.

[Drawing 12] It is the top view showing the stator of the fourth example of this invention.

[Drawing 13] The piece of an inclination is shown, (a) is the enlarged drawing seen from drawing 12 arrow-head A, and (b) is the enlarged drawing seen from drawing 12 arrow-head B.

[Drawing 14] It is the top view showing the stator of the fifth example of this invention.

[Drawing 15] The piece of an inclination is shown, (a) is the enlarged drawing seen from drawing 14 arrow-head A, and (b) is the enlarged drawing seen from drawing 14 arrow-head B.

[Drawing 16] It is the explanatory view having shown the principle of operation of the ultrasonic motor of a "vibrating reed type."
[Drawing 17] It is the side elevation showing the example of a type of the ultrasonic motor of a "vibrating reed type."
[Description of Notations]
10 Supporter
11 Cantilever
11a Free end
12 Piece of Drive
14 Mobile
15 Ultrasonic Vibrator
16 Piezoelectric Device
17 Supporter
18 Cantilever
18a Free end
20 Mobile
21 Piezoelectric Device

[Translation done.]